Introduction

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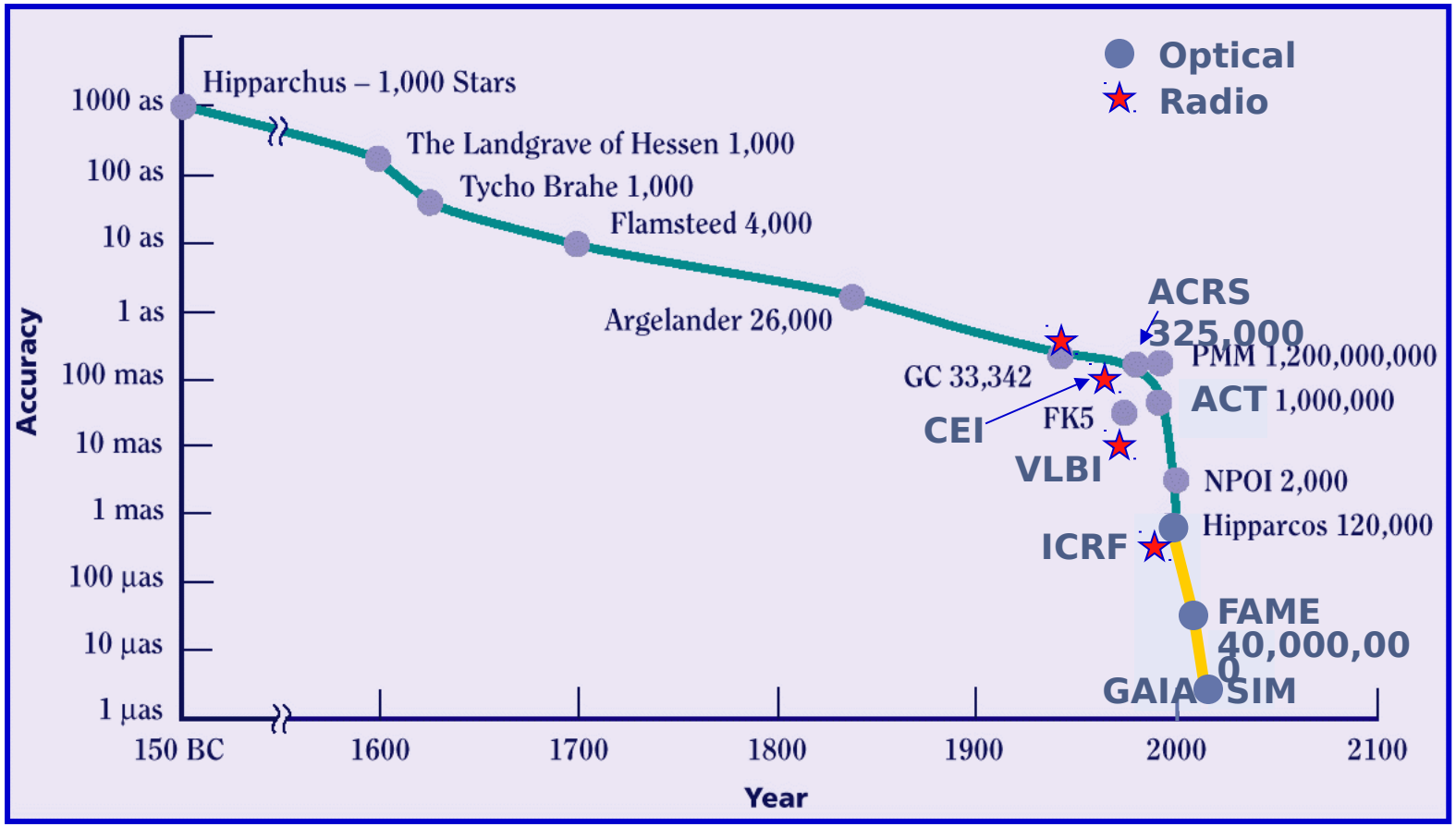
PDR Purpose

- **Evaluate Mature End-to-end Mission Concept**
  - **Ensure Minimum Science Goals Are Met**
- **Verify Mission Resources and Trade Offs**
  - **Science**
  - **Technical**
  - **Cost**
  - **Schedule**
- **Evaluate Team Performance**

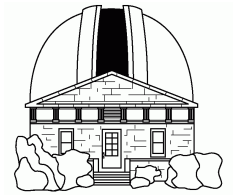
Goals of PDR

- **Accomplishments of Phase B**
- **Present Mission Design**

The Golden Age of Astrometry



Full-Sky Astrometric Mapping Explorer

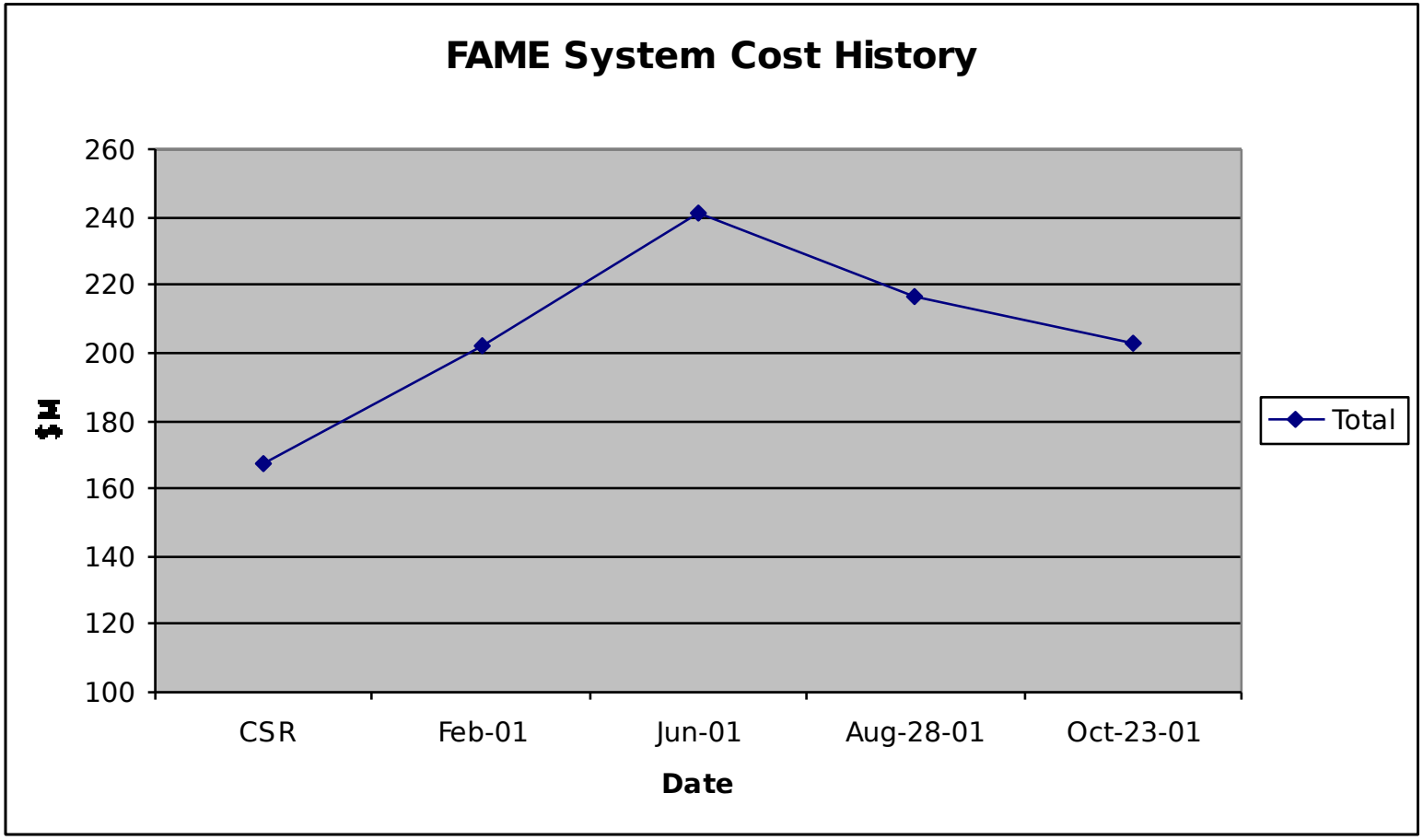


- **United States Naval Observatory**
  - **PI, Oversight of Science and Budget, MO&DA Lead, GDS, MOC, & SOC Development and Implementation, E/PO Lead**
- **Naval Research Laboratory**
  - **PM, System Engineering, S/C Bus Development, Integration, and Test, Comprehensive Testing**
- **Lockheed Martin Missiles and Space**
  - **Instrument Design, Fabrication, Testing, and Support**
- **Smithsonian Astrophysical Observatory**
  - **Synthesis and Verification of Scientific Measurement System, E/PO Support**

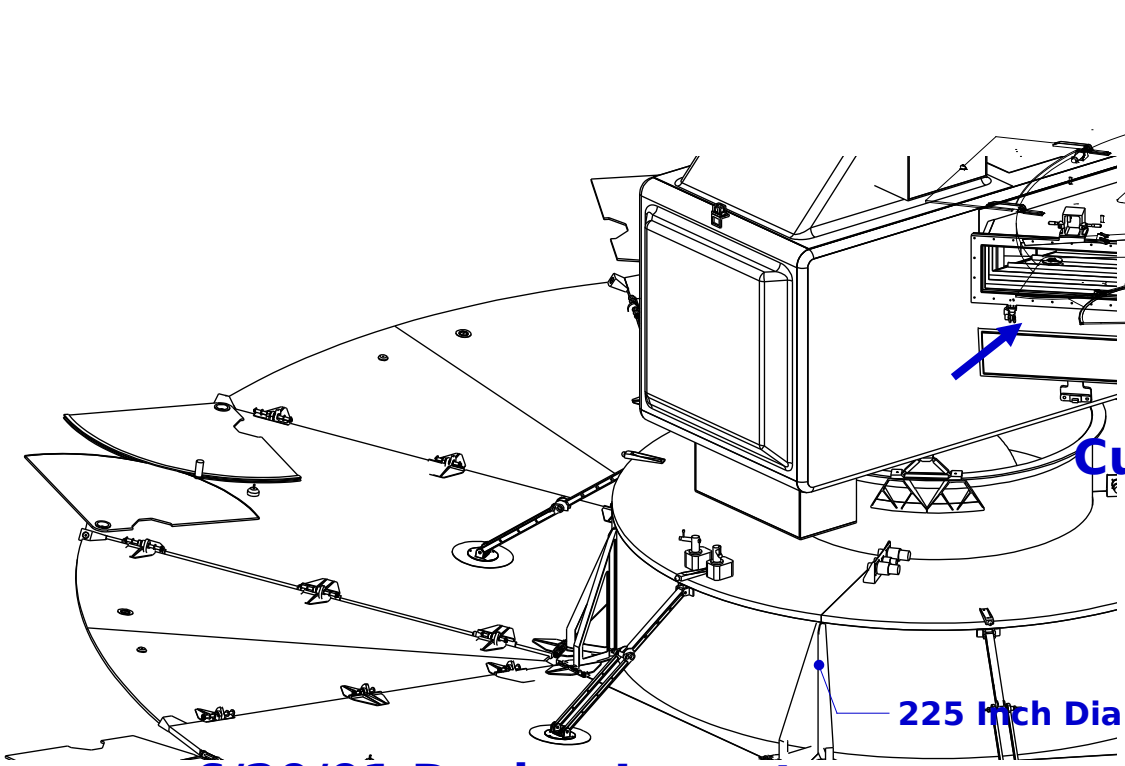
Technical Goals and Objectives of FAME

- **FAME Will Perform an All Sky, Astrometric Survey With Unprecedented Accuracy**
  - **Upgrades Existing Star Catalogs by Providing a Precision Catalog of 40 million Stars**
  - **Provides Positions of Bright Stars ($5<m_v<9$) to $<50\mu as$**
  - **Provides Positions of Fainter Stars ($9<m_v<15$) to $<500\mu as$**
  - **5 Year Mission Allows for Accurate Measurement of Stellar Parallax, Proper Motions, and Monitoring of Stellar Variability**
  - **Photometric Data in Two Sloan DSS Bands (R', I')**

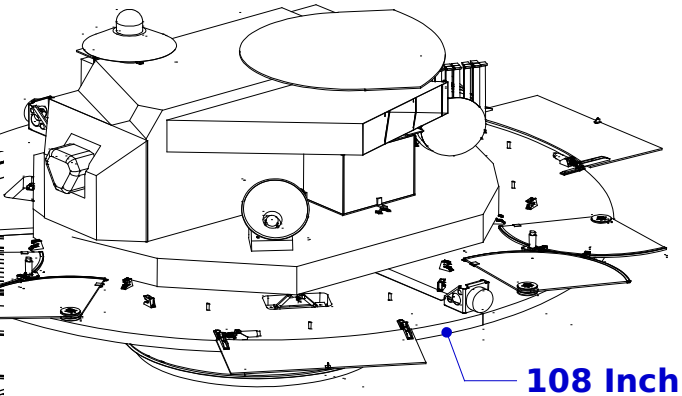
Cost History - System



Evolution of FAME



6/20/01 Design Layout



Current Design Layout

Not to Scale

Rescope Mission

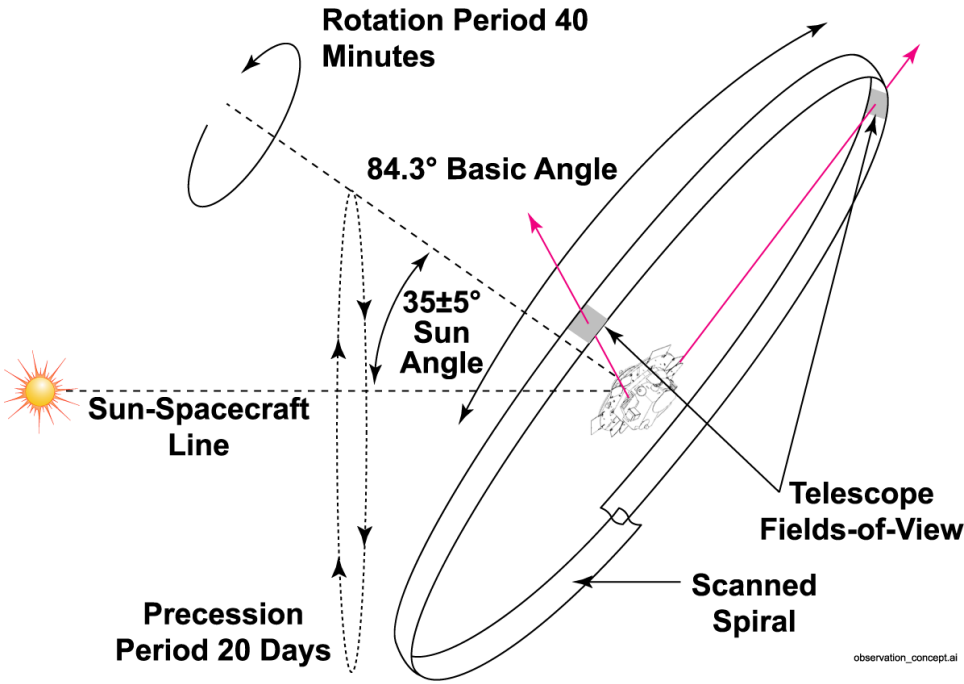
- **Phase B Design, AT Time of Instrument PDR Proposal**
  - **Cost Increase by 40%**
  - **Mass Allocation Exceeded**
  - **Power Allocation Exceeded**
- **Rescope**
  - **Reduce Size of Observatory**
  - **Contain Cost Growth**

Science Requirements

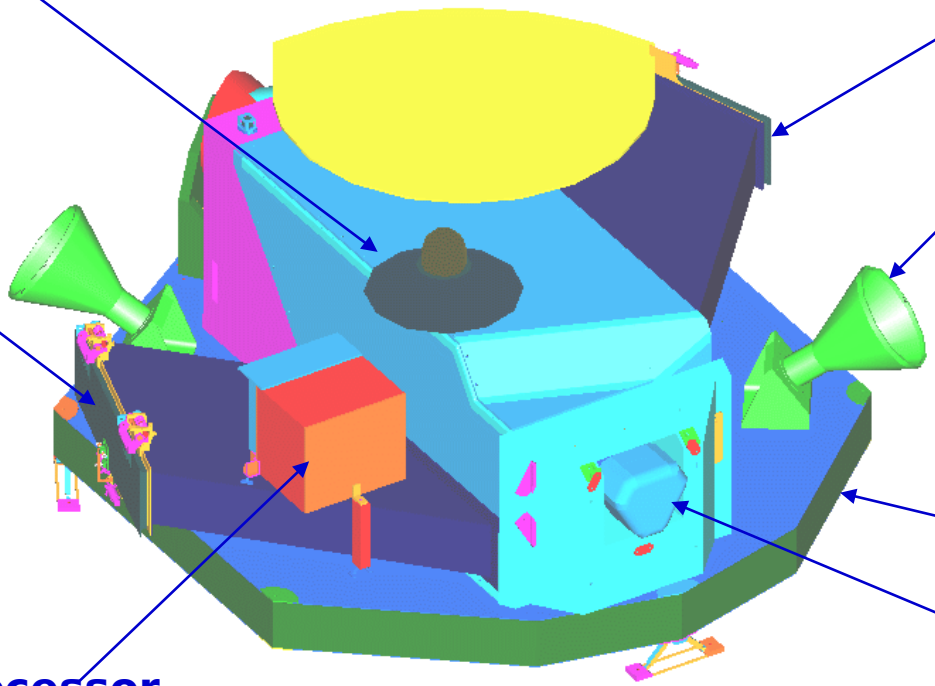
- **Astrometry**
  - **50μas Accuracy in Position, Parallax and Proper Motion 70 μas/yr for 9th Magnitude Stars**
  - **Astrometric Accuracy Degraded As a Function of Photon Noise to <500μas at 15th Magnitude**
- **Photometry**
  - **mmag Precision at 9th Magnitude in Astrometric Band**
  - **5mmag in Sloan Bands**
- **Impact of Rescope**
  - **5 Year Mission Needed to Achieve Science Requirements**

FAME Mission Description

- **The FAME Observing Concept**
  - **The Axis of the FAME Spacecraft Is Pointed 35° From the Sun and Precesses Around the Sun With a 20 Day Period**
  - **The FAME Spacecraft Rotates With a 40 Minute Period**
  - **The Two Fields of View Are Normal to the Rotation Axis and Are Separated by an 84.3° Basic Angle**
- **The Solar Radiation Pressure on the Solar Shield Results in Precession About the Sun-Spacecraft Line**
- **The Spacecraft Is in Near Geosychronous Orbit for Continuous Contact From Blossom Point Ground Station**

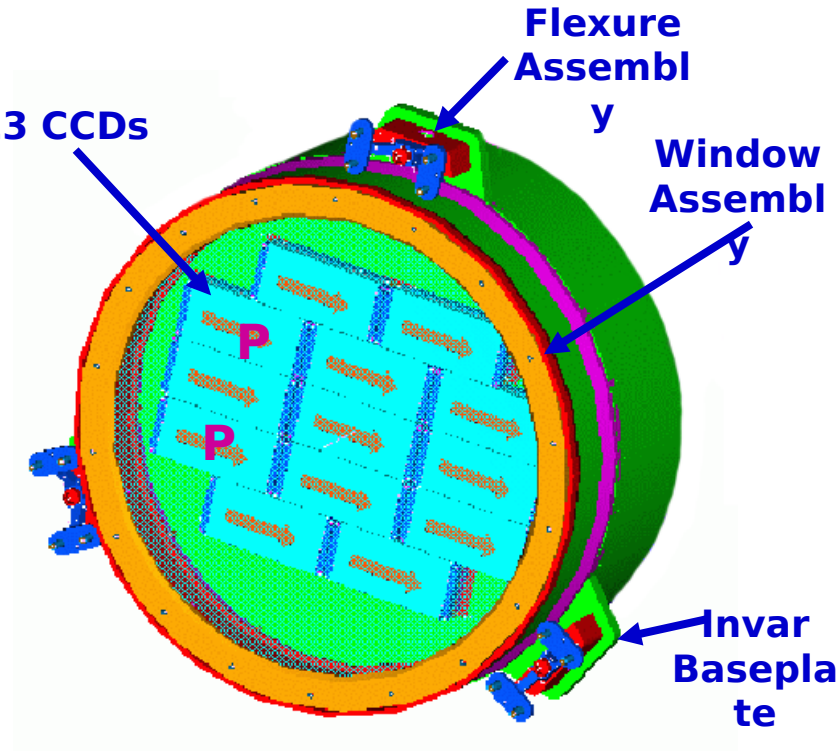


Instrument Layout (1 of 2)



Instrument Developed by Lockheed Martin Missiles and Space ATC

FAME Instrument Description (2 of 2)

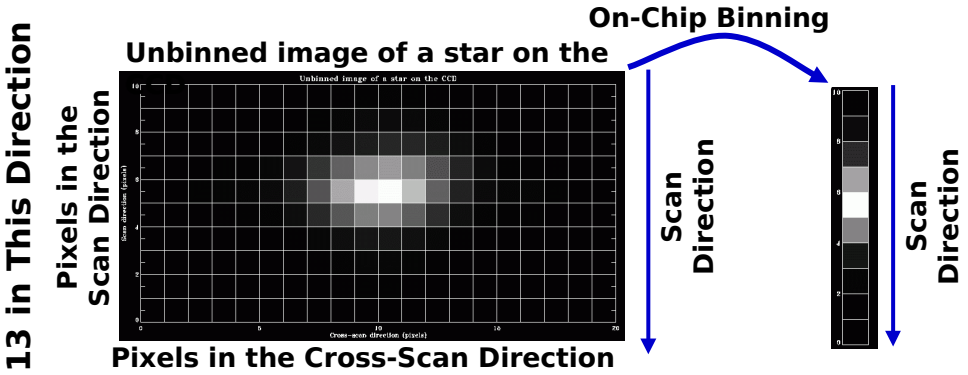


- The FAME Focal Plane
  - 13 2k·4k CCDs Arranged Within a 1.1° Diameter Field of View
  - Devices Marked With 'P' Are the 2 Photometric CCDs and the Rest Are the 11 Astrometric CCDs

- Telescope Produces Images of Stars on 13 Large Format CCDs
  - Images of Stars Are Continually Traversing CCD Array As the Spacecraft Rotates
  - CCDs Use Time Delay Integration
  - Synchronization of CCD Clock Rate and Image Motion Is Assured Via Rotation Rate Sensors
  - Star Images Are Windowed, Time Tagged, and Transmitted to Earth

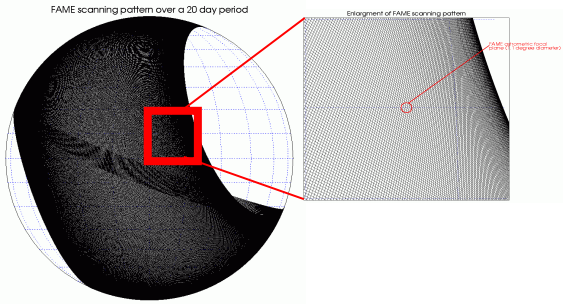
FAME Data Acquisition

On-Board Data Processing



- The Data From Most Stars Are Binned by 20 in the Cross-Scan Direction on the CCD Before Being Read-Out

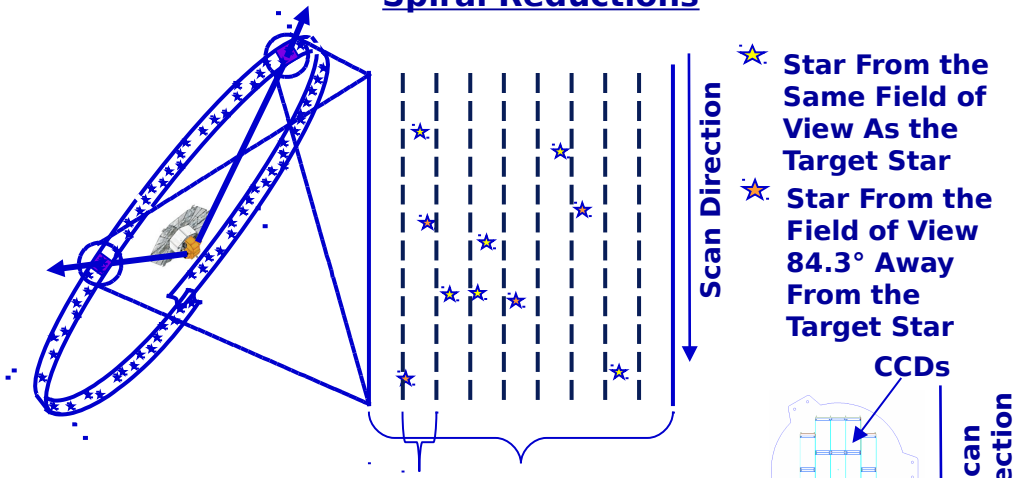
Sphere Reconstruction



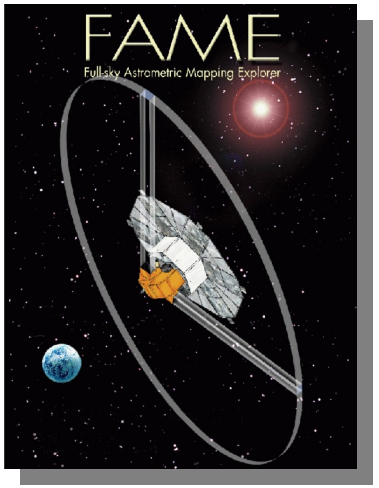
FAME Scan Pattern - The FAME Spacecraft Rotates With a 40 Minute Period Scanning the Two Apertures Across a Great Circle on the Sky. The 20 Day Precession of the Spacecraft About the Sun-spacecraft Line Results in FAME Covering the Entire Sky Every 20 Days Except for Exclusion Zones Within 35° of the Sun and the Anti-sun Direction.

- Use a Subset of the Stars to Globally Tie the Spirals Together Into a Sphere

Spiral Reductions

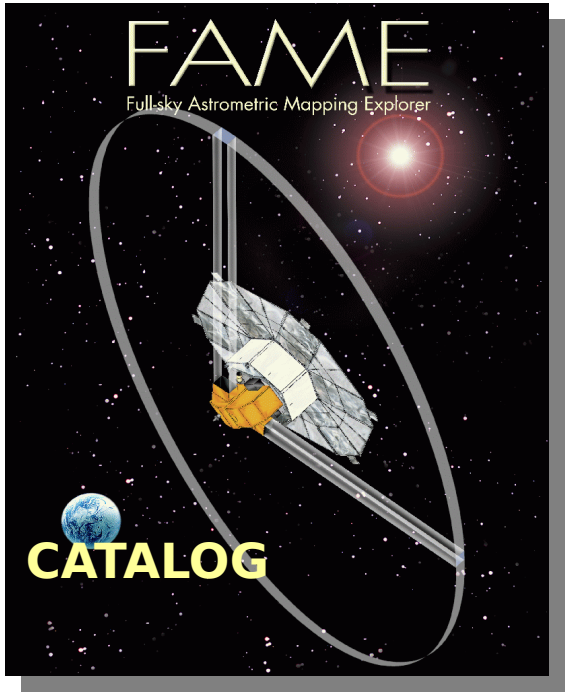


Catalog



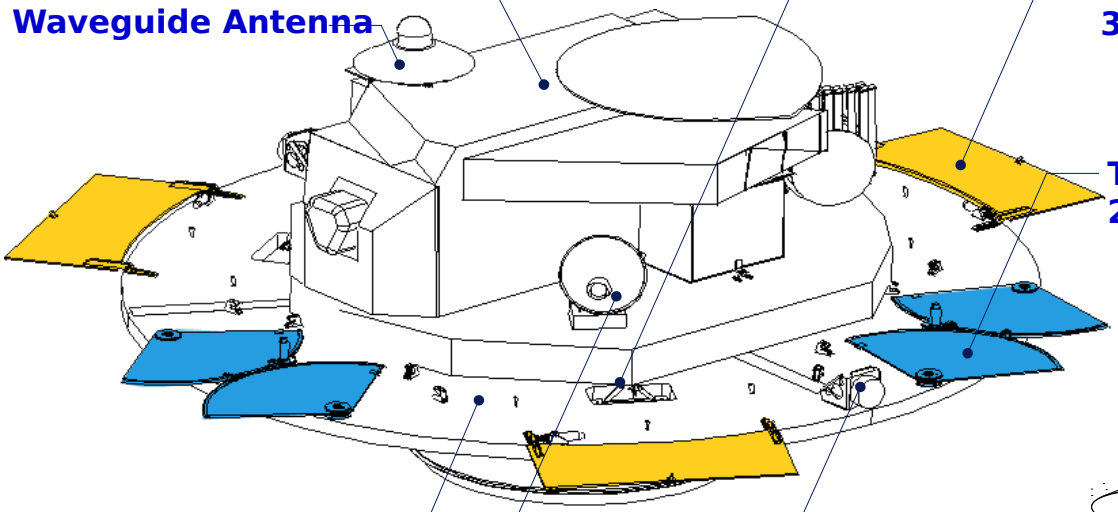
FAME Catalog

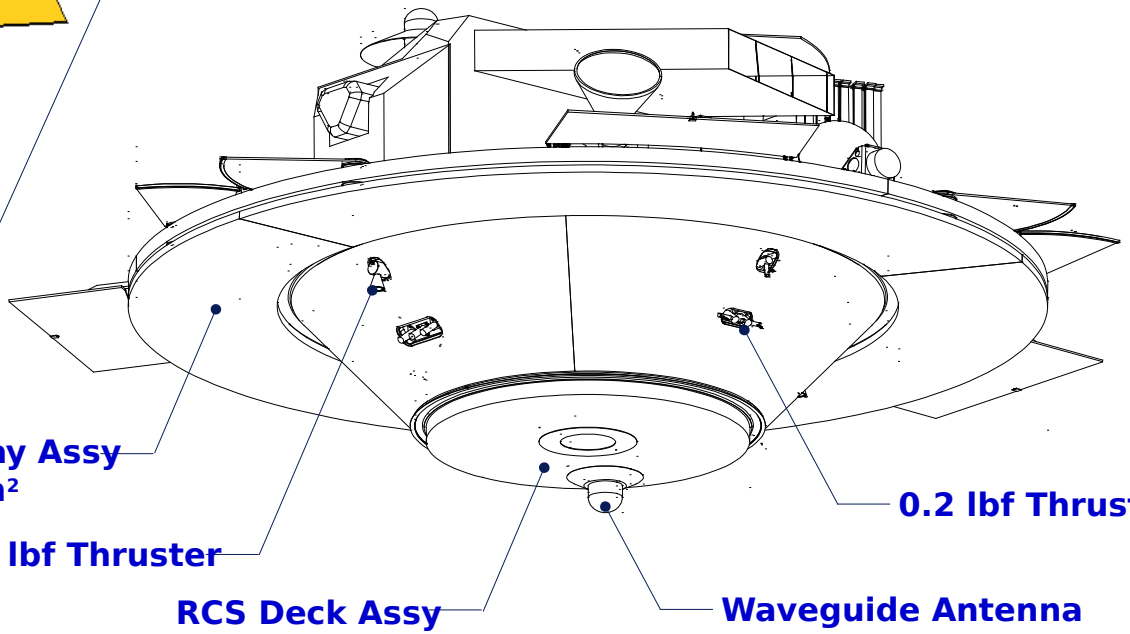
- **Initial Catalog Available 3½ Years After Launch**
- **Complete Catalog From the Extended Mission Available 6 Years After Launch**
- **90-95% of FAME Customers Will Want the Complete Catalog With Nominal Positions, Parallaxes, Proper Motions, and Photometry**
- **The Other 5-10% Will Be Interested in Variations of a Subset of the Catalog Over Time**



The Study of Fundamental Properties of a Large Sample of Stars Is Needed to Answer Many Key Astrophysical Questions

Operational Configuration

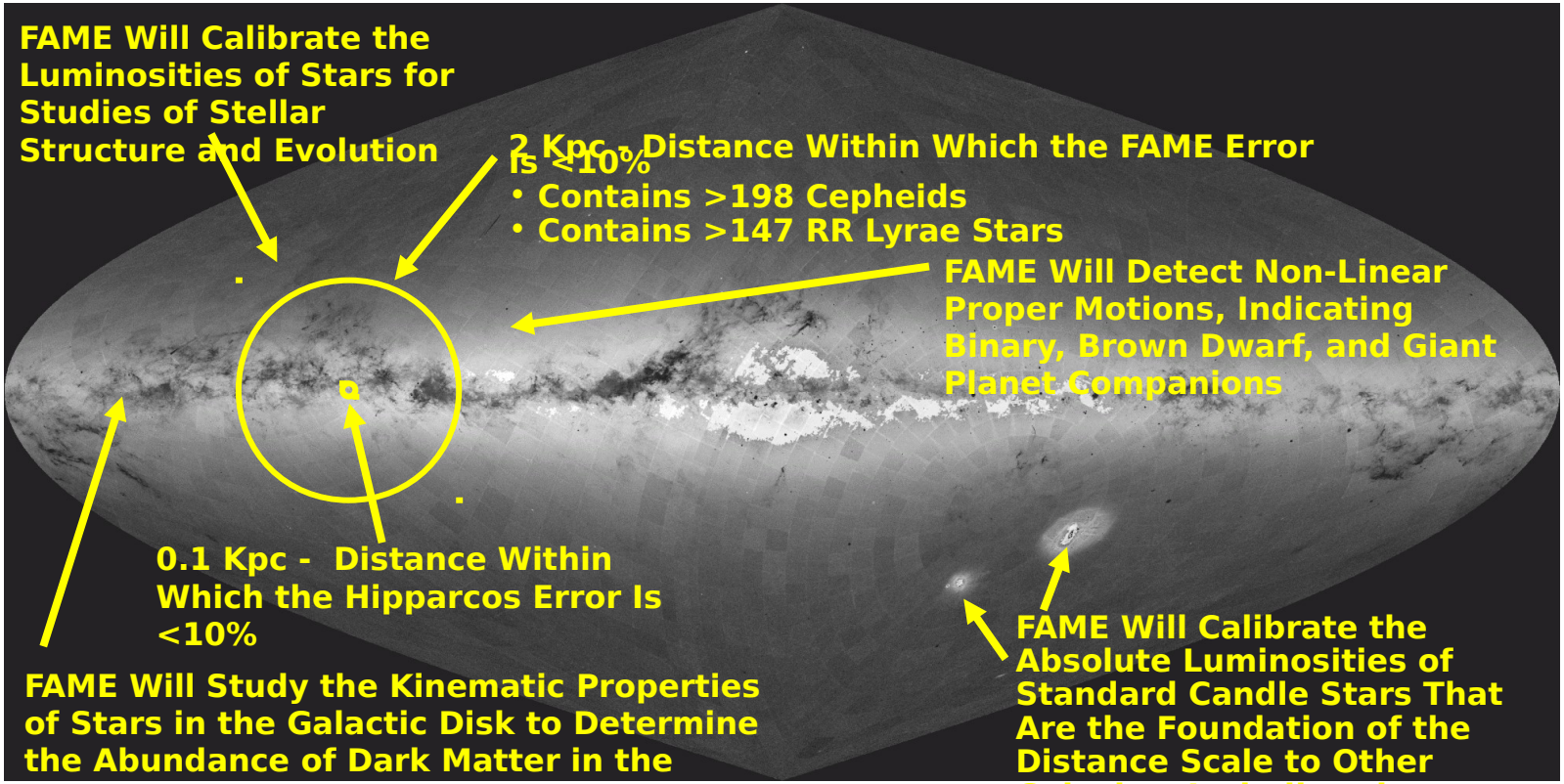




FAME Schedule

- **Phase A Concept Study**
  - **February - June 1999**
- **Phase B**
  - **September 2000 - November 2001**
- **Phase C**
  - **November 2001 - August 2002**
- **Phase D**
  - **September 2002 - November 2004**
- **Launch**
  - **November 2004**
- **Phase E**
  - **December 2004 - May 2007**
- **DoD Extended Mission**
  - **June 2007 - November 2010**

FAME Coverage of the Milky Way



- **FAME Science**
  - **FAME Will Map Our Quadrant of the Galaxy Out to 2 Kpc From the Sun Providing the Information Needed to Calibrate the Standard Candles That Define the Extragalactic Distance Scale, Calibrate the Absolute Luminosities of Stars of All Spectral Types for Studies of Stellar Structure and Evolution, and Detect Orbital Motions Caused by Brown Dwarfs and Giant Planets**
  - **FAME Will Improve on the Accuracies of Star Positions Determined by Hipparcos and Will Also Expand the Volume of Space for Which Accurate Positions Are Known by a Factor of 8,000**

Timeliness of FAME

- **A Major Catalog of Accurate Fundamental Stellar Properties Will Enable Advances Across Numerous Branches of Astrophysics**
- **FAME Will Define a Reference Grid That Can Be Used for SIM, TPF, and Space Navigation**
- **FAME Will Identify Interesting Targets for SIM and TPF, Increasing Their Scientific Return**
- **FAME Is an Appropriate Stepping Stone Between Hipparcos and GAIA**
- **Large CCD Array Cameras Are Now Routinely Built for Ground Applications and Are Ready for Space**

FAME Summary

- **Calibrate the Zero Point of the Extragalactic Distance Scale to 1%**
- **Determine Absolute Luminosities of a Wide Range of Spectral Types**
- **Detect a Meaningful Statistical Sample of Companion Stars, Brown Dwarfs, and Giant Planets**
- **Enable Studies of the Kinematics of Our Galaxy, Including the Effect of Dark Matter in the Disk**
- **Characterize Stellar Variability of a Large Sample of Stars at the 0.1% Level**
- **Define an Optical Reference Frame for Future Scientific Endeavors**